71493-1043 RAB:rld

AFFIDAVIT OF JIANGLEI MA
Relating to U.S. Patent Application 10/038,883 Filed
January 8, 2002

I, JIANGLEI MA of the City of Ottawa, of the Province of Ontario, in the Country of Canada, MAKE OATH AND SAY AS FOLLOWS:

1. I am a named inventor for the Patent Application 10/038,883 filed January 8, 2002, entitled SCATTERED PILOT PATTERN AND CHANNEL ESTIMATION METHOD FOR MIMO-OFDM SYSTEMS (hereinafter "The Application") and as such have knowledge of the facts contained herein.

2. Simulations were performed at least as early as May 17, 2001. Attached as Exhibit "A" are two screen shots that show the date of mat lab code of a channel estimation function based on the claimed pilot design and mat lab code *per se*. Referring to the mat lab code, the opening comment refers to STTD blocks. An STTD block is a space-time time-division transmission scheme which implies multiple antennas. In the code, the first loop is the interpolation in the time direction. The next loop is a filtering function. Finally the third loop is a interpolation in the frequency direction. These equations correspond to a pilot pattern that has the diamond shaped pattern that is the subject of this application.

3. Also attached as Exhibit "B" are excerpts from my notebook showing a drawing of the pilot pattern with a date of March 27, 2001. On page 76 of these notes, the drawing shows a header in the first row at the top of the drawing. This serves to show that the time direction is in the vertical direction and the frequency direction is in the horizontal direction of that figure. What follows is a diamond shaped lattice showing the position of the pilots. This pilot pattern was for a two antenna implementation.

4. The invention disclosed and claimed in The Application was conceived and competed in Canada as part of my duties for my employer. A submission describing my invention was received by the patent department of Nortel Networks Corporation (my employer) on July 4, 2001 and is attached hereto as Exhibit "C".

5. The invention was reviewed internally at Nortel with a disposition reached on August 1, 2001. Please see attached Exhibit "F".

6. The provisional application was outsourced to Smart & Biggar on August 28, 2001. Please see attached letter at Exhibit "D".

7. A first draft of the provisional was sent to my manager, Wen Tong, on October 15, 2001. Please see attached Exhibit "E".

8. The provisional application was then filed on October 17, 2001.

9. On December 17, 2001, I met with Allan Brett, a patent agent retained by my employer to prepare and file a regular patent application with the U.S.P.T.O. for my invention.

10. A first draft was received from Mr. Brett on December 20, 2001. A copy of the cover letter is attached at Exhibit "G". We met again on January 3, 2002. Formal documents were executed on January 7, 2002.

11. The regular application was filed on January 8, 2002.

12. The invention is the result of research and development that was completed in Canada.

SWORN BEFORE ME at the City of

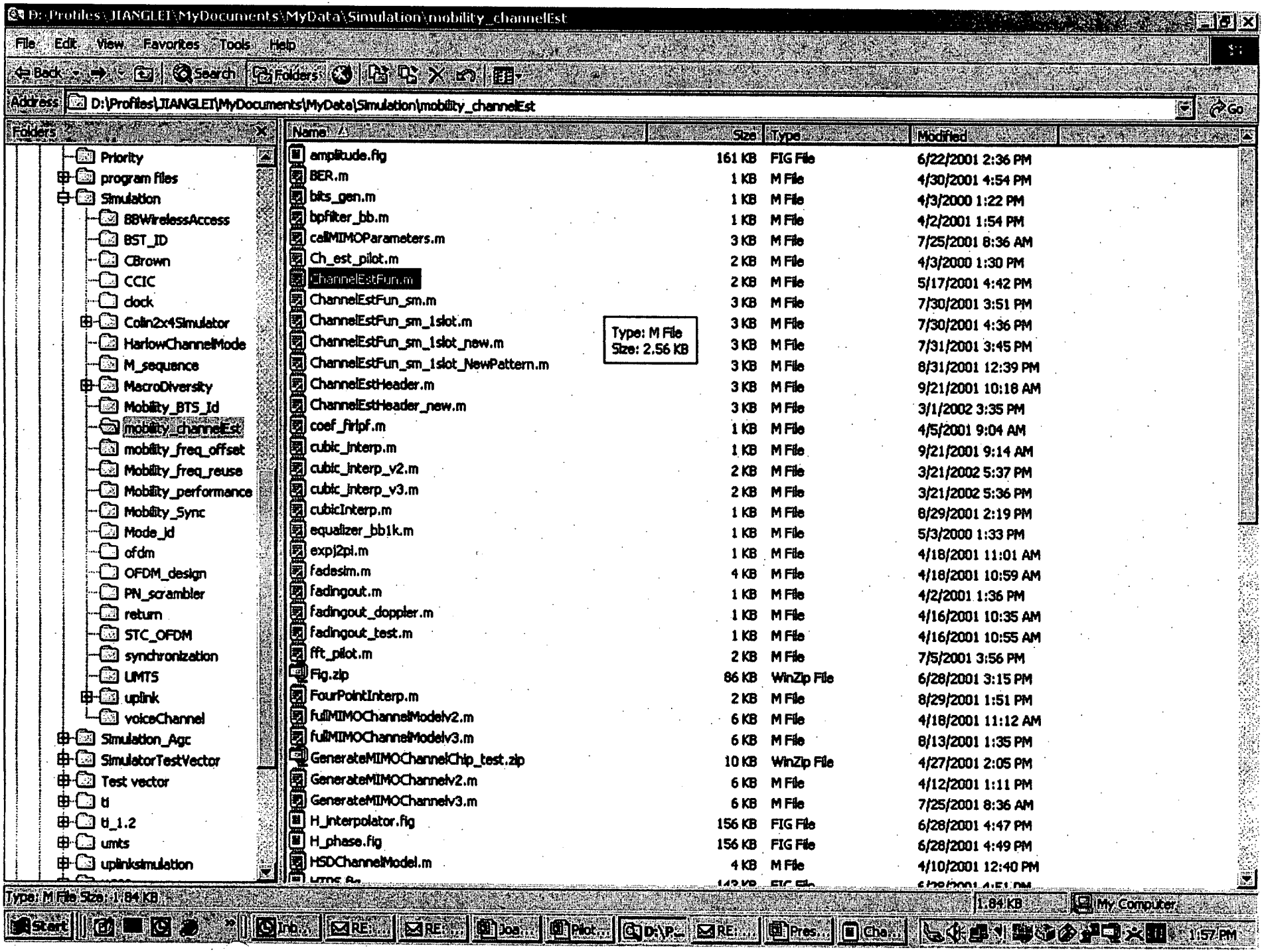
Ottawa, Ontario, Canada

this 30th day of January

2006.

A Commissioner, etc.

Jianglei Ma


D:\Profiles\JIANGLEI\MyDocuments\MyData\Simulation\mobility_channelEst
File Edit View Favorites Tools Help
Back Search Folders
Address D:\Profiles\JIANGLEI\MyDocuments\MyData\Simulation\mobility_channelEst
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clock
Colin2x4Simulator
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M_sequence
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Mobility_BTS_Id
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mobility_freq_offset
Mobility_freq_reuse
Mobility_performance
Mobility_Sync
Mode_Id
ofdm
OFDM_design
PN_scrambler
return
STC_OFDM
synchronization
UMTS
uplink
voiceChannel
Simulation_Agc
SimulatorTestVector
Test vector
ti
ti_1.2
umts
uplinksimulation
Name
Size
Type
Modified
amplitude.fig 161 KB FIG File 6/22/2001 2:36 PM
BER.m 1 KB M File 4/30/2001 4:54 PM
bits_gen.m 1 KB M File 4/3/2000 1:22 PM
bpfilter_bb.m 1 KB M File 4/2/2001 1:54 PM
cellMIMOParameters.m 3 KB M File 7/25/2001 8:36 AM
Ch_est_pilot.m 2 KB M File 4/3/2000 1:30 PM
ChannelEstFun.m 2 KB M File 5/17/2001 4:42 PM
ChannelEstFun_sm.m 3 KB M File 7/30/2001 3:51 PM
ChannelEstFun_sm_1slot.m 3 KB M File 7/30/2001 4:36 PM
ChannelEstFun_sm_1slot_new.m 3 KB M File 7/31/2001 3:45 PM
ChannelEstFun_sm_1slot_NewPattern.m 3 KB M File 8/31/2001 12:39 PM
ChannelEstHeader.m 3 KB M File 9/21/2001 10:18 AM
ChannelEstHeader_new.m 3 KB M File 3/1/2002 3:35 PM
coef_firlpf.m 1 KB M File 4/5/2001 9:04 AM
cubic_interp.m 1 KB M File 9/21/2001 9:14 AM
cubic_interp_v2.m 2 KB M File 3/21/2002 5:37 PM
cubic_interp_v3.m 2 KB M File 3/21/2002 5:36 PM
cubicInterp.m 1 KB M File 8/29/2001 2:19 PM
equalizer_bb1k.m 1 KB M File 5/3/2000 1:33 PM
expj2pi.m 1 KB M File 4/18/2001 11:01 AM
fadesim.m 4 KB M File 4/18/2001 10:59 AM
fadingout.m 1 KB M File 4/2/2001 1:36 PM
fadingout_doppler.m 1 KB M File 4/16/2001 10:35 AM
fadingout_test.m 1 KB M File 4/16/2001 10:55 AM
fft_pilot.m 2 KB M File 7/5/2001 3:56 PM
Fig.zip 86 KB WinZip File 6/28/2001 3:15 PM
FourPointInterp.m 2 KB M File 8/29/2001 1:51 PM
fullMIMOChannelModelv2.m 6 KB M File 4/18/2001 11:12 AM
fullMIMOChannelModelv3.m 6 KB M File 8/13/2001 1:35 PM
GenerateMIMOChannelChip_test.zip 10 KB WinZip File 4/27/2001 2:05 PM
GenerateMIMOChannelv2.m 6 KB M File 4/12/2001 1:11 PM
GenerateMIMOChannelv3.m 6 KB M File 7/25/2001 8:36 AM
H_interpolator.fig 156 KB FIG File 6/28/2001 4:47 PM
H_phase.fig 156 KB FIG File 6/28/2001 4:49 PM
HSDChannelModel.m 4 KB M File 4/10/2001 12:40 PM
Type: M File
Size: 2.56 KB
Type: M File Size: 1.84 KB
1.84 KB
My Computer
Start
1:57 PM

ChannelEstFun.m - WordPad

File Edit View Insert Format Help

```
%-----------------------------------------------------------------------
%
% Function to do the channel estimation based on PH and TPS
% File name: ChannelEstFun.m
%
% Author: Jianglei Ma
% Version: Version 0.01 May. 14, 2001
% h_in: channel matrix (2*NoSymPerSlot+2)xNoPilotF, [In]
%    the first  and second rows come from the last two rows in the previous channel matrix
% channelout: channel matrix (2*NoSymPerSlot)XNoPilotF, [Out]
%    the first row is for the last STTD block in the previous two slots, and the other three
%    are for the first three STTD blocks in the cureent 2 slots
% Copyright 2001, Nortel Networks Ltd.
%
%-----------------------------------------------------------------------
%function channelout = ChannelEstFun(h_in, D_t, D_f, NoPilotF, NoSymPerSlot, NoCarrier)


for ii = 2 : 4: 2*NoSymPerSlot

   % Interpolator in the time direction

   pilot_interp_t(ii/2,1:2:2*NoPilotF) = (h_in(ii/2,:)+ h_in(ii/2+2,:))/2;
   pilot_interp_t(ii/2,2:2:2*NoPilotF) = h_in(ii/2+1,:);
   pilot_interp_t(ii/2+1,1:2:2*NoPilotF) = h_in(ii/2+2,:);
   pilot_interp_t(ii/2+1,2:2:2*NoPilotF) = (h_in(ii/2+1,:)+h_in(ii/2+3,:))/2;

end

pilot_interp_t_sm(1,1)=pilot_interp_t(1,1);
pilot_interp_t_sm(1,2*NoPilotF)=pilot_interp_t(1,2*NoSymPerSlot);

for jj = 2: 2*NoPilotF-1
   if (jj == 2)
      pilot_interp_t_sm(1,jj) = (pilot_interp_t(1,jj-1)+pilot_interp_t(1,jj)+pilot_interp_t(1,jj+1))/3;
   else
      pilot_interp_t_sm(1,jj) = pilot_interp_t_sm(1,jj-1)+(pilot_interp_t(1,jj+1)-...
         pilot_interp_t(1,jj-2))/3;
   end
end
```

For Help, press F1

Start | Inb... | RE:... | RE:... | Doa... | Pilot... | D:\P... | RE:... | Pres... | Che... | 1:56 PM

```
%-------------------------------------------------------------------------
%
% Function to do the channel estimation based on PH and TPS
% File name: ChannelEstFun.m
%
% Author: Jianglei Ma
% Version: Version 0.01 May. 14, 2001
% h_in: channel matrix (2*NoSymPerSlot+2)xNoPilotF, [In]
%    the first  and second rows come from the last two rows in the
previous channel matrix
% channelout: channel matrix (2*NoSymPerSlot)XNoPilotF, [Out]
%    the first row is for the last STTD block in the previous two slots,
and the other three
%    are for the first three STTD blocks in the cureent 2 slots
% Copyright 2001, Nortel Networks Ltd.
%
%-------------------------------------------------------------------------
%function channelout = ChannelEstFun(h_in, D_t, D_f, NoPilotF,
NoSymPerSlot, NoCarrier)


for ii = 2 : 4: 2*NoSymPerSlot

   % Interpolator in the time direction

   pilot_interp_t(ii/2,1:2:2*NoPilotF) = (h_in(ii/2,:)+ h_in(ii/2+
2,:))/2;
   pilot_interp_t(ii/2,2:2:2*NoPilotF) = h_in(ii/2+1,:);
   pilot_interp_t(ii/2+1,1:2:2*NoPilotF) = h_in(ii/2+2,:);
   pilot_interp_t(ii/2+1,2:2:2*NoPilotF) = (h_in(ii/2+1,:)+h_in(ii/2+
3,:))/2;

end

pilot_interp_t_sm(1,1)=pilot_interp_t(1,1);
pilot_interp_t_sm(1,2*NoPilotF)=pilot_interp_t(1,2*NoSymPerSlot);

for jj = 2: 2*NoPilotF-1
   if (jj == 2)
      pilot_interp_t_sm(1,jj) = (pilot_interp_t(1,jj-1)+pilot_interp_t
(1,jj)+pilot_interp_t(1,jj+1))/3;
   else
      pilot_interp_t_sm(1,jj) = pilot_interp_t_sm(1,jj-1)+
(pilot_interp_t(1,jj+1)-...
         pilot_interp_t(1,jj-2))/3;
   end
end


% Interpolator in the frequency direction

for ii = 1:NoSymPerSlot
   Channel_interp_f(ii,:) = cubic_interp(D_f/2, pilot_interp_t(ii,:), 2
*NoPilotF);
end

Channel_interp_f_sm(1,:) = cubic_interp(D_f/2, pilot_interp_t_sm(1,:), 2
*NoPilotF);
channelout = Channel_interp_f;
```

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Subject / Objet:	Jianglei Ma		
From / De:	Jan. 2 01	To / À:	

White paper / Papier blanc
10 1/4" x 7 11/16"
260 mm x 195 mm

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* Phase Imbalance.

For the SICI (phase imbalance) to be greater than 20, 30, and 40 dB, the phase imbalance is required to be less than 11.42, 3.62 and 1.14 degrees respectively.

* Amplitude Imbalance

For more than 20, 30 and 40 dB signal-to-ICI ratio, it is required that the amplitude imbalance to be less than 1.74, 0.54, and 0.17 dB respectively.

UMTS 22% RCF

$$SNR = E_b/N_o + 5.85\ dB$$

$$SNR = E_b/N_o + 10\log_{10}(R/BW)\ dB$$

$$(R = 21.168\ Mb/s,\ BW = 5.508\ MHz)$$

ATANLUT.h → ATANLUT_old.h
add
atanLUT.h

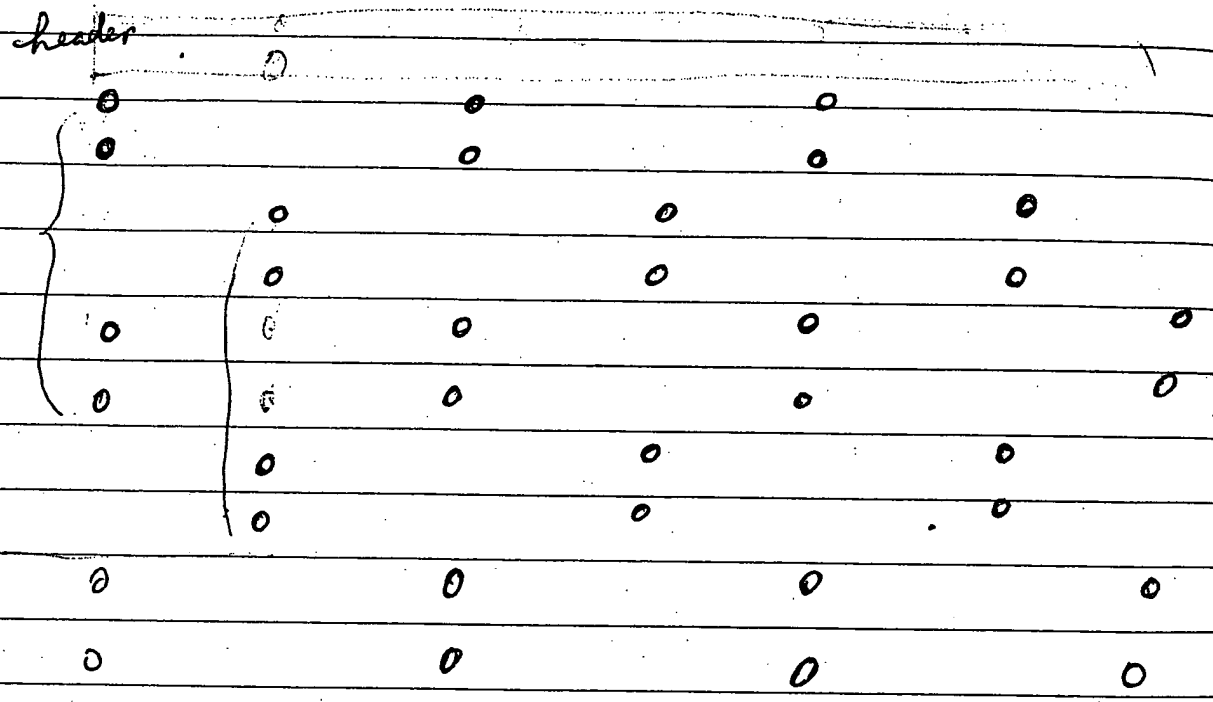
checked function: fftDescramble to fft.c
check fsyncEstimateFineOffset FreqCorrelation
and phaseCalculation to fsync.c

PNLUT.h → PnDescramble.h

Mar.2
arctan LUT → fsync_const.h
PN descrambling → pns_const.h

PNLUT.h → pns_const.h
checked fsync_const.h → to cvs
pns_const.h

C/I measurement



$\frac{1}{16} \rightarrow \frac{1}{8}$

According to Junhong:

input to IFFT : 16 bits

output from IFFT : (3 bits loss) → 11 bits

input : 7fff : no overflow

Apr. 2.

D:\simulation\mobility-channelEst

Mobile-channelEst.m

OFDM-Constant-mobile1K.m

1K mode: $f_s = 6.72$

$N\_carrier = 686$

$Npre = 96$ (N_cyc)

$Kmin = 169$

$Kmax = 854$

ChPH_Tx1 = interp(ChPH_Tx1_temp, N)

N=12: channel=4. Ndelay=22

OK

N=16

error occurs.

Apr. 3

$f_s = 5.61$ $N = 1122$

① $N = 530$ $f_s = 5.565$ MHz

$Npre = 18$ $Ttotal = \frac{10\times10^3}{15\times7} = 95.2380952\overline{38}$

$\frac{530}{5.565}$

② $N = 538$ $f_s = 5.649$ MHz

$Npre = 26$ $Tg = 4.60258$ μs

③ $N = 536$ $f_s = 5.628$ MHz

$BW_{LPF} = 0.8 f_s = 4.5024$ MHz

Invention Disclosure Submission Reply

Disc No:	14761RO	Received Date:	04 jul 2001
Disclosure Title:	Scattered Pilot Pattern for MIMO-OFDM System		

Inventors

Global Id	Name	Work Info	Home Info
0470051	**HR Name:** MA, JIANGLEI **Known As:** JIANGLEI **Email:** jianglei@americasm01.nt.com **Mgr First Name:** CLAUDE **Mgr Last Name:** ROYER **Mgr Global ID:** 0527503	**Location:** 100 CONSTELLATION CRESCENT NEPEAN ONTARIO K2G 6J8 CANADA **Location Code:** WDLN2 **Dept:** DP13 **Phone:** 3951853 **Ext Phone:** **Fax:** **Ext Fax:** **MailStop:** 65D19E04 **Citizenship:** CANADA	**Address:** 3 BON ECHO CRES. BRILDWOOD KANATA, ON CANADA K2M2W5 **Phone:** (613)8290816
0521795	**HR Name:** JIA, MING **Known As:** MING **Email:** mjia@americasm01.nt.com **Mgr First Name:** RUI **Mgr Last Name:** WANG **Mgr Global ID:** 0527503	**Location:** 100 CONSTELLATION CRESCENT NEPEAN ONTARIO K2G 6J8 CANADA **Location Code:** WDLN2 **Dept:** DP13 **Phone:** 3957131 769-7131 **Ext Phone:** (613) ~~265-2359~~ **Fax:** 6-395-6717 **Ext Fax:** **MailStop:** 65D19G05 **Citizenship:** CANADA	**Address:** 609 - 320 CROYDON AVE OTTAWA, ON CANADA K2B5P3 **Phone:** (613)8291886
0527503	**HR Name:** ZHU, PEIYING **Known As:** PEIYING **Email:** pyzhu@americasm01.nt.com **Mgr First Name:** CLAUDE **Mgr Last Name:** ROYER **Mgr Global ID:** 1614509	**Location:** 100 CONSTELLATION CRESCENT NEPEAN ONTARIO K2G 6J8 CANADA **Location Code:** WDLN2 **Dept:** DP13 **Phone:** 3958089 **Ext Phone:** 765-8089 **Fax:** **Ext Fax:** **MailStop:** 65D19F06	**Address:** 16 PEBBLE CREEK CRES KANATA, ON CANADA K2M2L4 **Phone:** (613)5917516

		Citizenship: CANADA	
050355 6	**HR Name:** TONG, WEN **Known As:** TONG **Email:** wentong@americasm01.nt.com **Mgr First Name:** CLAUDE **Mgr Last Name:** ROYER **Mgr Global ID:** 1614509	**Location:** 100 CONSTELLATION CRESCENT NEPEAN ONTARIO K2G 6J8 CANADA **Location Code:** WDLN2 **Dept:** DP20 **Phone:** 3931315 **Ext Phone:** 3931315 **Fax:** **Ext Fax:** **MailStop:** 65D19G06 **Citizenship:** CANADA	**Address:** 12 WHITESTONE DRIVE OTTAWA, ON CANADA K2C4A7 **Phone:** (613)7980466

Attachments

File Name	File Type	File Comments
Scattered_Pilot_V1.01.doc	Microsoft Word (*.doc)	

<End of Attachments>

Were there additional inventors involved:	yes	**Was there contractor involvement:**	no
Name of Supervisor or Divisional Head:		**Name of VP:**	
CLAUDE ROYER		ALAUDDIN JAVED	
LOB:	WIRELESS & CORE NETWORKS	**Business Unit:**	WIRELESS INTERNET
Conception Date:			
Has this invention been discussed with others? If so, please complete:			
Inside Nortel - Whom?	MIDTERM GROUP INCLUDING HARLOW GORUP	**Outside Nortel - Whom?**	
Inside Nortel - When?	25 apr 2001	**Outside Nortel - When?**	
NDA?	no		
Are you aware of any imminent future disclosures? Please provide dates and details:			
UMTS evolution workship in Oct. 2001 As Nortel proposal for 3GPP Release 6			
Keywords for Searching:		**Products that will use this invention:**	
Does this invention arise from any arrangement involving an external organization?		no	
Is this invention relevant to a Standards Activity?		**Internal Funding Project #'s:**	
~~no~~ yes as per last page		17538	

Technical Information

Brief Description of the Invention:

The wireless channel corrupts the transmit signal both in amplitude and in phase. In mobility application, the channel varies constantly due to the movement of the mobile terminal, therefore leads to significant performance loss. To perform optimal coherent detection at the mobile terminal the time varying channel characteristics should be estimated and tracked. For OFDM systems, pilot assisted channel estimation is a widely used approach where the known training symbols are multiplexed into the data stream at certain sub-channels (sub-carriers) and at certain time locations. The receiver interpolates the channel information derived from the pilot symbols and obtains the channel estimates for the data symbols.

The scattered pilot arrangement is important to keep the pilot overhead at the minimum while allowing the receiver to reconstruct the entire channel response as accurate as possible. For the typical wireless channels with both frequency and time dispersion, scattered pilots are inserted in the grid of both frequency and time direction. The grid density of the pilot symbols must satisfy the 2-D sampling theorem in order to construct a time and frequency varying channel response. The spacing between pilots in time domain is determined by the maximum Doppler frequency, while the spacing between pilots in the frequency domain is determined by the delay spread of the multi-path fading.

In MIMO OFDM system space-time coding technology is applied. Multiple channel information is required for the coherent space-time coding demodulation. This invention proposes a new scattered pilot pattern for MIMO OFDM system, which can be used to provide multiply channel information with limited grid density.

Problem Solved by the Invention:

MIMO-OFDM is employed to combat time and frequency dispersive channel suffering from multi-path propagation and Doppler spread. Reliable channel estimations are essential for performing coherent detection. Due to the multi-path fading and Doppler effect, scattered pilots are optimized to allow the accurate reconstruction of the current channel response with the least pilot overhead. The pilot pattern is important to channel estimation performance and overhead reduction.

Most work on the pilot grid pattern design is for the system with no transmitter diversity. The proposed scattered pilot pattern is designed for MIMO-OFDM system. In MIMO-OFDM system, multiple transmitters and receivers are used. For M-transmit and N-receive MIMO channel, MxN channel responses are required for space-time code demodulation in the receiver. This invention presents a novel scattered pilot pattern design for generic MIMO-OFDM systems.

In this invention, we first apply space-time coding technology to OFDM scattered pilot design, which can provide following features:

·Allow estimation of MxN channels with the same scattered pilot pattern
·Robust to both frequency and temporal fading with minimum overhead
·Cyclic rotation in time or in frequency of the scattered pilot pattern for BTS reuse
·Fast transform computing of scattered pilot without full size of FFT to save mobile battery.
·Power boost of scattered pilot to improve the performance

Solutions that have been tried and why they didn't work:

Most existing pilot pattern is designed only for Single Input Single Output (SISO) system and for Single Input Multiple Output (SIMO) systems. There are four types of the time-frequency distribution of the pilots: Type-A is a periodical insertion of the pilot OFDM symbols, in which all the sub-carriers are used as pilot sub-carriers. This scheme is only suitable to very slow time varying channels and fast frequency fading channels. Type-B is a cyclic insertion of the pilot sub-carrier symbol-by-symbol. This pattern is design for the slow fading channel both in time and in frequency. Type-C is a comb structure where the pilot arrangement is not changed with time. This pattern is a good choice for channels with very high Doppler but the required pilot density is high for frequency selective fsding channel. Type-D is scattered pilots. This scheme provides more robustness to deal with multi-path fading mobile channels.However the existing scattered pilot pattern is only suitable to the system without transmit diversity.

Specific elements or steps that solved the problem and how they do it:

For a M:N MIMO-OFDM channel, in order to achieve M*N individual channel response estimation, a straightforward pilot design is to introduce M*N set of pilots based on the SISO arrangement, hence to increase the pilot overhead by M*N times. In this invention, space-time-block-coding (STBC) is applied to the scattered pilots in the frequency domain without additional overhead. Therefore the pilots should allocate at the same sub-carriers (STBC block) for the OFDM symbol transmitted from all antennas. For adjacent STBC blocks the locations of the pilot sub-carriers are shifted by half of the pilot spacing in the frequency domain.

In a companion MIMOOFDM design arrangement, the scattered pilots are Differential-STBC (D-STBC) encoded: the scattered pilots are used as a fast common signaling channel (known as TPS channel). Given a successful decoding of the TPS, the channel response at the location of scatter pilots can be computed. Based on these MxN sets of scattered channel response, a 2-D channel reconstruction algorithm can be applied to obtain the entire 2xN channel estimations.

The key design criterion is based on the following technologies associated with the scattered pilot pattern:

·Lattice shape grid scattered pilots allow maximum span in time dispersion and frequency dispersion. Enable a simple 2-D channel reconstruction algorithm

·Pair-wise scattered pilots allow the D-STBC encoding to guarantee the adjacent D-STBC encoded the symbols at the same frequency response.

·The size and location of scattered pilot allow a special fast scattered-pilot transform algorithm to avoid full size FFT computing. Therefore allow mobile to save battery.

·The power boost of scattered pilot to enhance the channel estimation performance and such a power boost pattern can be cyclically rotated for adjacent BTS reuse.

Commercial value of the invention to Nortel and Nortel's major competitors:

If adopted in standard, this disclosure will be the essential IPR for Nortel. Nortel and its competitors will implement this scheme.

INTELLECTUAL PROPERTY LAW GROUP

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Fax (613)768-3017 (ESN 398)
kosabeka@nortelnetworks.com

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BY COURIER

August 28, 2001

- OK FOR Aug. 29/01 PJH

Mr. James McGraw
Smart & Biggar
900-55 Metcalfe Street
Ottawa, Ontario
K1P 5Y6

71493-1019
ON DOCKET
DC/45

Re: **Invention Disclosure No.: 14761ROUS01U**
Title: SCATTERED PILOT PATTERN FOR MIMO-OFDM SYSTEM
Inventors: Ming JIA et al.
Tel. Num. First Named Inventor: (613) 765-7131
Nortel Networks Servicing Agent: Jaspreet K. Harit
Required Filing Date: October 17, 2001
Contact Inventor: Immediately
Special Instructions: We recommend that Allan Brett draft this application. Please see Invention Disclosure Disposition for additional comments. Disclosures 14760RO and 14769RO are to be combined also into this application. Copies are enclosed.

Wen Tong is concerned about this

Dear Mr. McGraw:

Please find enclosed a new invention disclosure for which I would like you to prepare and file in the United States Patent and Trademark Office (USPTO) a patent application by the above-referenced filing date in accordance with Nortel Networks' guidelines.

Please ensure that when you meet with the inventors, they are advised of their responsibilities regarding their duty of candor to the USPTO, as well as any other relevant rules and/or laws including the best mode requirement.

Please send a substantially complete draft application to the Nortel Networks Servicing Agent, Jaspreet Harit, and the above-referenced inventors by **September 20, 2001**. If you foresee any problems with meeting this date or have any problems obtaining information from the inventor(s), please let me know as soon as possible.

Should you have any questions, please contact me directly.

Very truly yours,

Amie Kosabek

Amie Kosabek

Encl.: Copy of Invention Disclosure No. 14761ROUS01U
Copies of Invention Disclosures Nos. 14760RO and 14769RO
Letter regarding publication

BAB

S. Mark Budd
smbudd@smart-biggar.ca

Ottawa file no. 71493-1019

October 15, 2001

BY FACSIMILE

Wen Tong
Nortel Networks Limited
I.P. Law Group
P.O. Box 3511, Station C
Ottawa, Ontario
K1Y 4H7

Dear Mr. Tong:

Re: U.S. Patent Application
Applicant: NORTEL NETWORKS LIMITED
Inventor: Jianglei Ma, et al
Your Ref: 14761ROUSO1U
Title: SCATTERED PILOT PATTERN AND CHANNEL ESTIMATION METHOD FOR MIMO-OFDM SYSTEMS

Please find attached a draft of the patent application for the method of inserting pilot symbols and for the method of estimating channels, prepared by myself under the supervision of Allan Brett. Please read the draft and correct any areas that are inaccurate. If there is important wording that you do not agree with please suggest changes. Please satisfy yourself that the draft discloses the invention sufficiently that a person skilled in the art of OFDM communications would be able to implement your invention from information disclosed in the draft. Please also satisfy yourself that the draft discloses all relevant information regarding what you consider to be the preferred method of implementing the invention.

However, as this is a provisional application, we will not require a detailed review of the draft. Our main concern is the scope of the claims. We have drafted claims 1 and 7 which we think define broadly the monopoly to which we think you are entitled. This claims are deliberately broad, as this is a provisional application. The claims will be revised upon formalization of the application, and more detailed dependent claims will likely be added. Please consider these claims and let us know:

a) whether they contain all the essential features of the invention, and

b) whether they contain any features which are not essential to the invention.

We have a particular concern with two aspects of the claims, as I indicated in my e-mail of today. First, I have described the pilot patterns as a diamond lattice, using two subsets of the sub-carrier frequencies. Could you please let me know whether this is an essential feature of the invention? For example, could more than two subsets of sub-carrier frequencies by used, resulting in a skewed diamond lattice? Second, I have described the diamond lattice pattern of each transmitting antenna as being successively one symbol apart in the time domain. Could you please let me know whether and why this is necessary, and if it is not necessary, whether and why it is a preferable embodiment?

Due to the imminent disclosure of the invention, please provide us with your comments on the draft by fax or by e-mail not later than the evening of **October 16, 2001**. If you have any questions or concerns about the draft please feel free to call me at 232-2486 (ext. 327) or Allan Brett at 232-2486 (ext. 323). Thank you for your help. We look forward to receiving your response.

Yours very truly,

SMART & BIGGAR

S. Mark Budd

SMB:aba
Encl.

INVENTION DISCLOSURE DISPOSITION (IDD)

Disclosure No.: **14761RO (and also to include 14760RO & 14769RO, all three being combined into one application)**	Line of Business: WI
Disclosure Title: **Scattered Pilot Pattern for MIMO-OFDM System**	Product Group, VP & IP Prime: **Wireless Internet Technology Al Javed/Claude Royer/Peiying Zhu**
Inventors: **MA, Jianglei; JIA, Ming; ZHU, Peiying; TONG, Wen**	Reviewed By: Ottawa WI Patent Review Board **1 August 2001**
Product/Project: **Digital Comm. & Signal Processing Project No. 17538**	Standards Related: ☐ No ☒ Yes **3GPP UMTS**
Marketing Prime:	☒ Nortel Inventors only ☐ Nortel and Contractor Inventors

REVIEW SUMMARY

GIST OF THE INVENTION

Summarize within a few lines what the major thrust of the invention is *(e.g., a software program to be added to voice networks, such as Meridian, which will allow instantaneous translations from French to English).*

--Scattered pilot pattern for MIMO-OFDM system, where arrangement of pilots allows for multiple antennae. So different pilot info, but at same time and frequency.

BENEFIT FROM THE INVENTION

Summarize within a few lines how the invention will benefit its target benefactor *(e.g., subscribers able to retrieve multi-lingual messages without use of additional time consuming translation processes).*

--Scattered pilot pattern is receiver independent.
(Further advantages in IDS).

Ranking/Scoring Data

a. Technological Thrust: __3_ (0-3)

b. Inventive Value: __2_ (0-3)

For 3 cases combined, Namely 14761RO, 14760RO, and 14769RO.

c. Commercial Value: _3_ (0-3) - **If accepted in standards.**

OVERALL SCORE: __8__

FINAL DISPOSITION

☒ **File Patent Application for 14761RO, 14760RO and 14769RO combined.**
Target Filing Date: **OCTOBER 17, 2001**

☐ Reconsider/Table (see comments below)
Other (e.g., publish, Tech. Licensing, etc.)

Comments:
Critical Filing Date (If Applicable): **OCTOBER 18-19, 2001 - Planned disclosure at 3GPP Future Evolution Workshop**

Foreign Filing: ☐ **No – File No Further Filing Certification**
(Initial Determination) ☒ **Yes** **To be reassessed closer to 1 year further filing deadline.**
(circle)Tier 1_____ **Tier 2:** _____
(GB, DE, FR, CA,__) (Please specify
Estimated Cost: $7,000 Estimated Cost: $17,000

Completed by: _____**J.K. Harit**_____ **Dated: August 1, 2001**
Approved by: _____ **Dated:** _____

(Revised March 16, 2001)

Allan Brett
abrett@smart-biggar.ca

Ottawa file no. 71493-1043

December 20, 2001

Ms. Jianglei Ma
Nortel Networks Limited
100 Constellation Crescent
Nepean, ON K2G 6J8

VIA COURIER

Dear Ms. Ma:

Re: Proposed U.S. Patent Application
Applicant: JIANGLEI MA, ET AL
Inventor: Jianglei Ma, et al
Title: PHYSICAL LAYER PACKET STRUCTURE AND FRAME HEADER DESIGN FOR MIMO-OFDM SYSTEM
Your Ref: 14761ROUS02U

Please find enclosed a first draft patent application for another of the OFDM cases. Like the first case you have already reviewed, the two inventions in this case are somewhat disjoint, but so long as they are claimed and described clearly this is okay.

Please review the entire draft in detail and feel free to mark up the copy provided.

As discussed, I need to receive comments from you on this early in the first week of January so that I may file the case by Friday, January 4, 2002 at the latest.

Please pay particular attention to the claims to ensure that I have claimed all of the aspects which you believe to be inventive.

I look forward to receiving your comments.

I look forward to receiving your comments.

Yours very truly,

SMART & BIGGAR

Allan Brett

RAB:rld
Encl.

c.c. Jaspreet Harit
(with enclosures)